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Cutting Insert and Method

Field of the Invention

The present invention relates to a cutting insert for chip removing machining and a method for manufacturing the cutting insert according to the preamble of the appended independent claims 1 and 9.

Background of the Invention

In tools for metalworking, indexable, asymmetrical inserts of hard and wear-resistant materials are used, such as cemented carbide or cubic boron nitride (CBN). There are a number of embodiments of cutting inserts for use in only one feeding direction. These are usually denominated right or left hand inserts and comprise peripheries and/or chip breakers having an asymmetrical shape in relation to the bisector of a cutting corner. These cutting inserts are adapted for only one feeding direction.

Examples of indexable inserts having asymmetrical cutting corners are shown in US-A-3 955 259, SE 517274 (WO 0047405), GB 1443743 and US-A-3 229 349.

Objects of the Invention

One object of the present invention is to provide a cutting insert that avoids the above-mentioned drawbacks.

Another object of the present invention is to provide an indexable cutting insert that only is of left or right hand design.

Another additional object of the present invention is to provide a cutting insert, which can utilize both sides of the cutting insert.

Another additional object of the present invention is to provide an efficient method for manufacturing the cutting insert.

This is realised by a cutting insert that has been given the features according to the appended claims.

Brief Description of the Drawings

An embodiment of the indexable insert according to the present invention is described below, reference being made to the appended drawings, wherein; Fig. 1A shows a planar view of a triangular indexable insert according to the present invention, Fig. 1B shows a cross-section of the indexable insert according to the line IB-IB in Fig. 1A, Fig. 1C shows a cross-section of the indexable insert according to the line IC-IC in Fig. 1A, Fig. 1D shows a cross-section of the indexable insert according to the line ID-ID in Fig. 1A, Fig. 1E shows an enlargement of a cutting corner in Fig. 1A, Fig. 1F shows the cutting corner in perspective view, Fig. 1G shows the indexable insert in perspective view, Fig. 2A shows the indexable insert at longitudinal turning in a workpiece, Fig. 2B shows the indexable insert at transverse turning in a workpiece, Fig. 2C shows the indexable insert at copying a workpiece on a lathe, Fig. 3A shows a planar view of a rhombic indexable insert according to the present invention, Fig. 3B shows an enlargement of a cutting corner in Fig. 3A in perspective view, Fig. 3C shows a cross-section of the indexable insert according to the line IIIC-IIIC in Fig. 3A, Fig. 3D shows a cross-section of the indexable insert according to the line IC-IC in Fig. 1A, and Fig. 3E shows a cross-section of the indexable insert according to the line IIIE-IIIE in Fig. 1A.

Detailed Description of Preferred Embodiments of the Invention

The indexable insert 10 in Figs. 1A–1G is intended for turning or milling. The cutting insert, which is shown in right hand design, has a substantially triangular basic shape and comprises a top side 11, a bottom side 12, and three edge surfaces 13, which substantially connects the top and bottom sides 11 and 12, respectively. The cutting insert 10 has a negative geometry, i.e. each edge surface 13 is perpendicular to a plane P, which coincides with the top side 11 or the bottom side 12, which means that the cutting insert has a substantially constant clearance angle around the cutting insert, also in the cutting corners.

The cutting insert consists of sintered cemented carbide (for instance WC + Co) or cubic boron nitride (CBN) or a combination of CBN and cemented carbide where the cutting corners consist of CBN plates.

The top side 11 constitutes rake face and the edge surface 13 constitutes edge surface. Upper major cutting edges 15A are formed at transitions between the top side 11 and the edge surfaces 13 of the cutting insert. Lower cutting edges 16A are formed at transitions between the bottom side 12 and the edge surfaces 13. Said sides 11, 12 constitute a rake face in a position when the side 11 is active in chip forming machining and a support surface when the cutting insert has been turned upside down. Each side 11, 12 comprises a planar surface, the periphery of which may be provided with an edge strengthening chamfer 14.

The cutting insert 10 has three cutting corners 17. Each cutting corner 17 comprises a nose edge 18 and a minor cutting edge 19. The nose edge 18 connects to the connected major cutting edge 15A and to the connected minor cutting edge 19. The minor cutting edge 19, which also may be called finishing edge or wiper, in turn connects to a non-associated major cutting edge 15B.

The cutting corner 17 has a bisector B dividing the corner into equal parts (30 degrees each, in this case) in relation to the major cutting edges 15A, 15B. The bisector B intersects the nose edge 18, at both the top and the bottom sides 11, 12. Each cutting corner 17 is asymmetrical in relation to the bisector B in regards of the geometry of the edges 15A, 18, 19 and 15B.

The nose edge 18 is curved and may be defined by a radius R1. The minor cutting edge 19 is curved and may be defined by a radius R2. The radius R1 is smaller than the radius R2 of the minor cutting edge. The minor cutting edge 19 connects to the non-associated major cutting edge 15B with a radius R3. The radius R3 is smaller than the radius R2 of the minor cutting edge but larger than the radius R1.

Each side 11, 12 comprises three nose edges, which at least partly touch a plane P. The plane P is in this case parallel with both the top and the bottom sides.

An imaginary line L, which is perpendicular to the plane P and tangent to the minor cutting edge 19, intersects the edge surface 13 at a distance L1 from the minor cutting edge. The distance L1 equals about half of the thickness L2 of the cutting insert, Fig. 1G. The line L coincides with the edge surface 13 for about half of the thickness L2 of the cutting insert. The edge surface 13 has a step 20A, 20B on both sides of the bisector of the cutting corner. The step 20A, 20B is substantially parallel with the plane P. The step 20A, 20B forms a sharp corner 21 with the edge surface 13 next to the step 20A, 20B in order to constitute an indication of fracture that at a possible breaking of the cutting edge controls the breakage and keeps the lower part of the cutting insert intact.

A direction oriented, double-sided wiper insert having only 3 radii in the cutting corner has the advantage that it is possible to form a radius or shoulder in a workpiece 30 to an exact geometry without the need for compensation in the NC program, i.e. the cutting insert leaves the workpiece having the same geometrical shape as a standard turning insert having a nose edge according to the ISO standard. This at the same time as the cutting insert has a wiper effect at longitudinal turning. I.e. the cutting insert leaves the workpiece having the same geometrical shape as a standard turning insert having a nose radius according to the standardized norm. Furthermore, a cutting insert formed in such a way provides lower radial cutting forces, which is desirable at generation of fine surfaces, than a traditional wiper insert having 5 radii after each other.

Thus, the invention aims at getting away from this type of problem by forming only half of the thickness, and thereby obtaining a double-sided wiper insert that only is of left or right hand design. The step 20A, 20B protects the subjacent edge in an effective way. Since the cutting inserts are expensive, such as CBN inserts, the operator often machines too long. Without a wiper, this entails numerous measurement corrections in the turning lathe. The CBN insert maintains the measurements well, even after considerable wear. Finally, it breaks down. The indexable insert according to the present invention ensures that the cutting edge below is protected.

Fig. 2A shows the indexable insert at longitudinal turning of the workpiece 30 with the feeding direction according to the arrow in Fig. 2A. Fig. 2B shows the

indexable insert 10 at transverse turning of the workpiece 30, wherein the minor cutting edge substantially does not machine the same. Fig. 2C shows the indexable insert during copying of the workpiece 30 on a lathe.

In all the machining examples, the cutting insert has been mounted in insert holders with a setting angle of 93°, and a clearance angle and minor insert angle of 6° each.

The indexable insert 10 is manufactured in the following way. A polygonal plate of a hard wear-resistant material such as CBN, having a thickness L2 and equally large side surfaces, is fastened in a fixture. The edge surfaces are ground over the entire thickness in a conventional way. At least a first corner portion is machined, preferably by means of grinding, so that a first area, corresponding to approximately half the thickness, obtains a rounded nose edge 18 and a minor cutting edge 19. It is suitable to perform the corresponding machining on the other corner portions of the plate and then turn the polygonal plate upside down 180°. The plate is fastened in the fixture again in order to machine some of the corner portions, at least the first corner portion, preferably by means of grinding, so that a second area, corresponding to approximately half of the thickness, obtains a rounded nose edge 18 and a minor cutting edge 19. Then, it is advantageous to machine the nose edge 18 so that it obtains a radius R1 that is smaller than the radius R2 of the minor cutting edge. It is most suitable to grind all corner portions of one of the halves in one set-up.

The indexable insert 10' in Figs. 3A–3E is intended for turning or milling. The cutting insert has a substantially rhombic basic shape with two cutting corners 17' and four cutting edge portions. Equally indexed reference numbers designate equal details mentioned above. What makes this cutting insert 10' different from the above-described cutting insert 10, in addition to the basic shape, is the shape of the edge surface 13' in the cutting corner 17'. This cutting insert 10' is injection-moulded or directly pressed and the edge surface 13' in the cutting corner has a continuous or stepless transition between the opposite cutting edges in a cutting corner. The cutting corner 17 has a nose edge 18' and a minor cutting edge 19'. The nose edge 18' connects to the associated major cutting edge 15A' and to the associated minor cutting edge 19'. The minor

cutting edge 19' in turn connects to a non-associated major cutting edge 15B'. An imaginary line L', which is perpendicular to the plane P' and tangent to the minor cutting edge 19' intersects the edge surface 13' according to Fig. 3D. A line, corresponding to the line L', which is tangent to both of the nose edges 18', runs at a distance from the centre of the edge surface 13', in the plane of the bisector B, according to Fig. 3C. In the illustrated cutting insert 10', the edge surface 13' is concave.

Furthermore, the cutting insert 10' has a through hole intended to receive a fixing screw (not shown), which fixes the cutting insert 10' to the insert holder.

Thus, the present invention relates to an indexable, asymmetrical cutting insert, which is of only left or only right hand design that permits utilisation of both sides of the cutting insert for machining in the same direction. Furthermore, an efficient method for manufacturing the double-sided cutting insert is provided.

The invention is in no way limited to the embodiment described above, but may be varied within the scope of the appended claims. The cutting insert may have another polygonal basic shape, such as a square, rectangular, pentagonal, hexagonal or octagonal basic shape. The cutting insert 10 may be provided with a through hole intended to receive a fixing screw.